NEW ORLEANS FORECAST DISTRICT.

During the first three weeks the areas of high pessure that appeared in the Northwest and passed eastward or dissipated were not of sufficient intensity to cause a general break in the period of hot, dry weather that prevailed in most interior sections of the western and central portions of the district.

The most important area of high pressure appeared on the 21st and its southward advance over the district terminated the drought and was attended by a period of comparatively cool weather.

Conditions were favorable during the month for frequent showers in the coast section of Louisiana.

No storm warnings were issued or required.—*R. A. Dyke.*

DENVER FORECAST DISTRICT.

No low pressure areas of importance affected the district during the month, and the temperature was considerably below the normal for August throughout the district. The month was characterized by a large number of high-pressure areas on the eastern slope, most of which moved southward from the Canadian Northwest, resulting in frequent showers and much cloudy weather in eastern Colorado. At Denver the number of rainy days was 16, being the greatest recorded at Denver in August since the year 1875.

No special warnings were issued or required.—*Frederick W. Brist.*

SAN FRANCISCO, FORECAST DISTRICT.

The only warnings issued during August were for a spell of warm weather on the 6th and for rain on the 20th. The first applied to northern California, and while warm weather prevailed for several days, it did not become as warm as expected.

The special rain warning was issued to only a few places in the counties just north of San Francisco, and it was fully verified. Many prunes were being dried in the sun in this part of the State at this time, and the warnings were received early enough to enable the growers to stack their trays, and thus protect the fruit from injury.

The principal feature of the month was the presence of a LOW off the north California coast that first appeared on the 11th, and it persisted till the end of the month. It moved every day, sometimes coming closer to the coast and other times retreating farther westward. Also at times it would move some distance to the north and again to the south. On the 16th it was quite close to the Washington coast, and a portion evidently became detached from the parent storm and crossed the Rocky Mountains on the 19th, causing showers in scattered places in the northern portion of this district on one or two days.

Another portion of the Gulf of Alaska LOW moved inland on the 21st, and in consequence good rains fell for two or three days in the North Pacific States, and unsettled weather prevailed in the northern half of California. The pressure was also relatively low over Bering Sea during practically the entire month.—*E. A. Beals.*

RIVERS AND FLOODS.

By H. C. FRANKENFIELD, Meteorologist.

Stages in nearly all rivers of the country indicated the approach of the annual low-water season that usually reaches its culmination in late autumn. Floods occurred in only a few rivers, and they were very moderate and of little consequence. Over the Saluda and Santee drainage areas of South Carolina rains were frequent and heavy, anf the rivers were above the average mean stage for August, with floods occurring at the close of the month in both rivers. Warnings were issued at the proper time and no losses were reported, as no crops had been planted in the lowlands on account of continued high water. Stages were also quite high at the same time in the interior rivers of Georgia, but there were no floods. The usual advices were issued.

Moderate to heavy rains fell over the drainage area of the upper Arkansas River about the middle of the month, and flood warnings were issued for all points from La Junta, Colo., to Mulvane, Kans. Flood stages were exceeded at Fort Lyon, Colo., and Dodge City, Kans., with crests of 8.6 feet, or 2.6 feet above flood stage, at Fort Lyon on the 22d, and of 5.8 feet, or 0.8 foot above flood stage, at Dodge City on the 24th.

Among the losses in Colorado was that of an irrigation reservoir dam on the Apishapa River, a tributary of the Arkansas, resulting in an estimated damage of $697,000, while the estimated value of property saved by the warnings was placed at $200,000. In Kansas the total losses amounted to $44,860, of which $28,500 was in crops, in hand and prospective. Erosion of abutting lands caused losses of about $10,000.

A destructive summer flood occurred near the middle of the month in northern Utah, and following will be found a report thereon, prepared by Mr. J. Cecil Alter, Meteorologist in Charge of the Weather Bureau Office at Salt Lake City, Utah:

FLOODS AT FARMINGTON AND WILLARD, UTAH.

Local thundershowers at dusk, Monday evening, August 13, 1923, along the west slope of the Wasatch Mountains in northern Utah, produced the most intense downpour of record in the Salt Lake City rain gage, with unusually heavy rains at a few other places near the foot of the mountains, and sent the most destructive floods of record in the State, consisting largely of earth and rocks, out of the steep canyons at Farmington and Willard, 16 and 50 miles, respectively, north of Salt Lake City. Nine human lives were destroyed, and the loss at Farmington and Willard is estimated at from $105,000 to $120,000.

The storm, which gathered slowly during the late afternoon without exceptional manifestations of wind, lightning, or other phenomena, occurred in connection with a shallow, circular LOW charted over southern Idaho and northern Utah that morning, but which formed an arm from southeastern Wyoming to a Mississippi valley LOW 24 hours later. The heavy rains were rather local, however, little or none falling over Great Salt Lake and the western part of the Salt Lake (City) valley, while stations in the Wasatch Mountains received less rain than stations along the base of the range.

Descending onto the business section of Salt Lake City, street elevation about 4,300 feet above the sea, at 6:38 p. m., new records for rainfall intensity were established as follows: In 5 minutes (6:53 to 6:58) 0.35 inch, 10 minutes 0.56 inch, 15 minutes 0.76 inch, 30 minutes 1.05 inches, 1 hour 1.17 inches, and 2 hours 1.23 inches, this being the total for the storm, and a new 24-hour record for August. In the minute ending at 6:55 p. m. 0.10 inch fell, this probably being a new record; sprinkles preceded and followed the rain for some time. At the University of Utah, 2 miles due east, elevation 4,500

feet, 0.80 inch fell, and at Mountain Dell, 11 miles east, elevation 5,500 feet, the storm amounted to 0.65 inch.

An automatic record was obtained at High Line, City Creek, 8 miles northeast, elevation 5,300 feet, on a Marvin float gage. As at Salt Lake City, the rain began very suddenly at 6:39 p. m., accumulating according to the tracing, 0.25 inch in 10 minutes, 0.67 inch in 20 minutes, 0.90 inch in 30 minutes, 0.94 inch in 40 minutes, 0.97 inch in 50 minutes, 1.01 inches in 1 hour, 1.12 inches in 1½ hours, and 1.15 inches for the storm. These amounts are exceptional, being unequaled for intensity in the short record available. The rain amounted to 1.34 inches at Farmington, elevation 4,267 feet, falling between 7:30 p. m. and 9 p. m.; while at Morgan, 12 miles east by northeast of Farmington, over the divide, elevation 5,080 feet, only 0.15 inch fell.

The rain began somewhat earlier over the Farmington watershed, evidently, as the flood crashed onto the town within 15 or 20 minutes after rain began in Farmington. Gathering flotsam and débris of a rather heavy nature, the flood waters were checked at intervals in the narrower parts of the channel, and thus an immense head of water was soon accumulated. Finally the moving dam and reservoir dashed through the winding but wider portion of the canyon, being the last 2 or 3 miles, with tremendous power and devastation.

A large wad of mud was contributed by Mud Creek, a branch from the north about 3 miles from the canyon outlet. Immediately below Mud Creek outlet a concrete intake dam and a few hundred feet of wood stave pipe line were swept away, the flood crest having already caught eight work horses almost from the hands of their drivers another mile up the main canyon.

Gaining destructiveness by the addition of rocks and trees caved from the creek bank, the flood evidently hit a tourist camp site, about 2 miles above the canyon outlet, without warning. Four Boy Scouts, Wilford I. Langton, George Jackson, and Ted and Vernon Rudy, and Mr. and Mrs. Walter J. Wright, were presumably settled there for the night, and their bodies, partly dismembered and horribly mangled, were found in the lower part of the canyon, or well outside, in the path of the flood.

The lower or last mile or so of the canyon was gored and scoured to great depths, and an incalculable tonnage of earth and rocks was evacuated far out into the valley through the north edge of Farmington town, which is about a mile from the outlet. About half of the brick electric plant, a mile within the canyon, was carried away, four houses at Farmington were badly damaged; and several streets, the State highway, and the Bamberger Electric Railroad were covered with mud for many rods.

Arnold Christensen overexhausted himself while rescuing his wife and children from the flood in which they were being carried, and died instantly of heart failure. Approximately 20 acres of land in crops were deeply overlaid with earth and bowlders and rendered useless for farming purposes, while about 125 acres were partially or temporarily damaged. Steed Canyon and two other arroyos south of Farmington discharged unusual volumes of earth and rocks, one of them covering a small acreage of land near Centerville. The total loss in the neighborhood of Farmington is probably around $30,000 or $35,000.

The Willard Canyon discharge was much greater and more destructive, though it is thought the precipitation was little, if any, heavier. The precipitation at Brigham City, elevation 4,310 feet, 7 miles north, was only 0.63 inch, while at Ogden, elevation, 4,310 feet, 15 miles south, it was 1.04 inches. Willard Canyon is very steep and stony, with an extended series of crooked narrows, and in this choked channel the débris-laden flood was dammed and held back sufficient to allow a great head of water to gather at intervals.

Thus on leaving the narrows this tremendous volume of water dashed through the lower mile of the canyon at great speed, digging up and carrying away an unmeasurable tonnage of sand, gravel, and bowlders. An iron pipe line about a foot in diameter and extending from the head of the narrows to the electric plant near town, a distance of nearly 2 miles, was demolished and carried away; while the electric plant, on a gently sloping surface in the flood path, was bombarded with bowlders, one of them weighing about 12 tons, and the entire east wall was destroyed.

A tongue of mud and rocks from 500 to 750 feet wide darted across the south edge of Willard town, situated about three-eighths of a mile from the canyon outlet, sweeping four residences completely away and damaging many others. Two women—Mrs. Agnes M. Ward and her mother-in-law, Mrs. Mary E. B. Ward—perished when one of the buildings collapsed, and several other persons narrowly escaped casualties.

This flooded strip, comprising approximately 100 acres, including several blocks of improved town property, is covered from 1 to 3 feet deep with earth and bowlders. Another tongue of mud and bowlders from the canyon outlet shot across the north edge of town, approximately along the old stream channel, covering about 55 acres. Probably 15 per cent of the land covered can not be salvaged for agricultural or residence purposes.

A number of barns, granaries, small outbuildings, and fences, together with much poultry and many small pigs, were completely or partially destroyed, and 15 residences were more or less damaged by having porches and annexes crushed or carried away, basements filled, and ground floors besmeared with mud, and the yards and orchards deeply covered with mud, gravel, and rocks. A considerable amount of farming machinery, several automobiles, and some harvested crops were also deeply covered or badly damaged. The total loss of land, crops, and improvements is estimated at $75,000 or $85,000, largely in electric-plant installations.

The Willard Canyon watershed is rather compact, precipitous, and rocky, probably covering around 15 or 18 square miles. It was being grazed by cattle, sheep, and horses. The stream channel was scoured to bedrock through several thousand feet, the exposed surfaces showing much watermarking, as if by previous floods, though hidden by sediment, rocks, and sand for untold years. Huge bowlders clogged in the sediment of previous floods, exposed but not carried away, also showed rounded corners, gained no doubt in previous floods, probably before the pioneers came to Utah in 1847. There is little or no forested land in the canyon.

The Farmington watershed is somewhat more extensive and is longer and less precipitous. Some cattle, horses, and sheep were grazing the area, and occasional grass and brush fires in past years have aided in preventing vegetation from setting densely. There is very little, if any, forest cover. The stream channel in the canyon was freshly eroded to bedrock in a few spots, these spots showing the abrasions of earlier floods.

Important floods have come out of both canyons since Utah was settled, and some of the evidences of previous flooding may have been produced at those times; but the belief of a number of examiners is that there were prehistoric floods of great extent. The inference is thus compelling that such floods might occur again under

similarly favorable conditions of the watershed or the downpour of rain. Since the canyons have been recently cleansed, particularly Willard Canyon, a heavy rain could not now carry out nearly so much débris.

There is unquestionably an important connection between these floods and the partial denudation of the ground cover of the watersheds by vegetation, fires, and livestock grazing. But without touching the question of lessening the flood danger by a simple reduction in the number of livestock grazed, it is worthy of mention that the heavy rain occurring in City Creek Canyon, which debouches near the business center of Salt Lake City, as shown by the Marvin float gage at the High Line, served to raise the stream only 0.27 foot, or about 3 inches. The watershed comprises about 25 or 30 square miles, much of it being rather steep; but it has not been grazed at all, nor extensively burned over, for about 20 years.

Flood stages during August, 1923.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE.					
	Feet.			*Feet.*	
Santee: Rimini, S. C.	12	31	(1)	12.9	31
Saluda: Pelzer, S. C.	7	29	29	11.9	29
MISSISSIPPI DRAINAGE.					
Arkansas:					
Fort Lyon, Colo.	6	18	18	8.0	18
Do.	6	22	22	8.6	22
Dodge City, Kans.	5	20	20	5.8	24
Purgatoire: Higbee, Colo.	4	22	22	4.8	22

[1] Continued into September.

MEAN LAKE LEVELS DURING AUGUST, 1923.

By UNITED STATES LAKE SURVEY.

[Detroit, Mich., Sept. 5, 1923.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.[1]			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during August, 1923:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sea level at New York	602.06	579.76	571.70	245.41
Above or below—				
Mean stage of July, 1923	+0.19	−0.13	−0.34	−0.39
Mean stage of August, 1922	−0.53	−0.83	−0.80	−1.15
Average stage for August, last 10 years	−0.67	−1.20	−1.08	−1.15
Highest recorded August stage	−1.87	−3.75	−2.41	−2.85
Lowest recorded August stage	+0.46	−0.09	+0.32	+1.06
Average relation of the August level to—				
July, level	.....	−0.10	−0.20	−0.30
September, level	.....	+0.20	+0.30	+0.40

[1] Lake St. Clair's level: In August, 574.61 feet.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, AUGUST, 1923.

By J. B. KINCER, Meteorologist.

The droughty conditions that obtained in the lower Great Plains from southern Kansas southward at the close of July were much intensified by continued absence of rain during the first three weeks of August. Hot and dry weather prevailed in that area resulting in a general and, in some cases, marked deterioration in growing crops. The drought was especially severe in Oklahoma, and scattered showers that were received in Texas and southern Kansas were mainly ineffective. The last week of the month brought relief, however, when heavy rains occurred in the driest portion of the area, and fairly well-distributed showers in most other sections. The rain came too late, however, for some crops in Oklahoma, but others, such as truck, late cotton, and sorghum, were materially benefited.

Winter wheat harvest was practically completed during the first half of the month, except in a few late districts, but there was considerable delay in threshing, because of wet weather, in the Ohio and upper Mississippi Valleys and in Nebraska. The cooler weather the first part of the month favored the filling of spring grains in central Rocky Mountain districts, while showers were beneficial in the central Plateau sections of the West. Threshing small grains advanced satisfactorily during the latter part of the month in the Northern States, but there was considerable damage to grain in shock by wet weather in some central valley districts.

Timely and beneficial showers, with good growing temperatures, gave very favorable conditions for corn during the first two decades of the month throughout the principal producing districts, except in the southern Great Plains and in northern Iowa where moisture was deficient. This crop was badly damaged by drought in Oklahoma and portions of the adjoining States. The latter part of the month, however, was much too cool for corn in the great central valleys, the Central-Northern and Northeastern States, and at its close the crop needed more sunshine and warmth generally. Conditions continued rather favorable, however, in the extreme lower Missouri Valley and much of the Central Plains area.

The month was generally unfavorable for cotton. The severe drought in the western portion of the belt caused general deterioration in Texas, while much complaint of wilting and shedding, with bolls opening prematurely, was received from Oklahoma. Rainfall was less frequent, however, in most of the eastern portions of the belt, particularly in southeastern localities, but there was little response of the crop to the more favorable conditions, while the latter part of the month again brought cloudy, showery, and unfavorable weather. The drought was broken in the western portion of the belt near the close of the month, and shedding and premature opening were checked, with a general improvement in condition in most sections.

There was sufficient rainfall to maintain pastures in good condition in all sections east of the Mississippi River, except that they were short in most places from the Lake region eastward. In many portions of New York the water supply was low, while it was much too dry in many other sections of the Northeastern States. Showers in the far Southwest materially improved the range, while the generous rains from the southern Plains southward the latter part of the month were of great benefit.

Fruit generally did well, though there was some frost damage to cranberries in Wisconsin the latter part of the month. Fruits were especially promising in the far West, and citrus developed well in both Florida and California, though rain was needed locally in parts of the former State.